Structural Equation Model Determinants of Risk Factors for Hypertension Status in Urban Areas in Kotabumi 1 Community Health Center, North Lampung Regency, Lampung Province, Indonesia

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Abstract. WHO, 2021 estimates 1.28 billion adults aged 30-79 years worldwide suffer from hypertension. Identify the significant influence of socio-economic factors and risk factors for the occurrence of hypertension status and prove the hypothesis. Case and control studies in November-December 2022 328 samples, 164 case groups and 164 control groups aged > 18 years who live in the urban area of the Kotabumi Health Center I North Lampung Regency, Lampung Province, Indonesia. Latent variables consist of Hypertension, Socio-economic, Environmental, Lifestyle, and Health Services, which are measured through appropriate indicators. Data collection was carried out through observation, in-depth interviews and questionnaires. Data analysis with Structural Equation Modeling (SEM) PLS 3.0. Determinants of socio-economic variables, health services, environment and lifestyle have a significant relationship to the incidence of hypertension by 55.8% in urban areas of North Lampung Regency, indicating that education, access to health services, stress levels and physical activity affect the status of events is the strongest indicator in explaining the causes of hypertension. This research can support the hypertension control program by improving socio-economic, health services through increased access to health services, the environment to reduce stress levels, and lifestyle through increased physical activity. It needs the support of other stakeholders, especially in urban areas in low-income countries and middle class who have socioeconomic as the main problem that caused the incident hypertension, including Indonesia.
1. Introduction

More than 1 in 4 men and 1 in 5 women suffer from hypertension. It is estimated that 1.28 billion adults aged 30-79 years worldwide suffer from hypertension [19]. Hypertension is a condition where the systolic blood pressure is ≥140 mmHg and the diastolic pressure is ≥90 mmHg [2]. Hypertension is a disease that is commonly found in health centres. Hypertension is the silent killer usually without complaints so sometimes patients or health workers do not know about it and there is no anticipation of prevention earlier unless the patient accesses health services, as a result of this delay the risk of myocardial infarction, stroke, acute kidney failure and also death occurs [14].

Several studies have linked the incidence of hypertension to many factors, both modifiable and non-modifiable. Factors that cannot be modified are genetic factors and factors that can be modified are risk factors caused by, among others, environmental factors, health care factors, and lifestyle factors [1].

From the several factors found above, efforts are sought to control hypertension to reduce the prevalence of hypertension cases in the community and find out the factors that can be a predictive model for the incidence of hypertension, this is done because it is impossible to carry out tests without measuring the variables that cause hypertension. the incidence of hypertension is the risk factor for hypertension sometimes latent variables cannot be measured directly but need to be measured using indicators which are then measured between exogenous and endogenous latent variables, analysis that can be used to measure this is SEM analysis which is known as a combination of multiple regression analysis and integrated factor analysis. Based on BPS data for 2020 Lampung Province consists of 15 Regencies/Cities and one of them is North Lampung Regency. North Lampung has a classification of urban villages and rural villages, Kotabumi 1 is included in the classification of urban areas. Kotabumi 1 is one of the most densely populated areas in the North Lampung area, in terms of the prevalence of hypertension cases it has a high rate of 78.59%, characteristically the area is included in urban characteristics [5]. This study uses case and control data which aims to determine the risk factors that influence the incidence of hypertension in urban areas, especially at the Kotabumi 1 Health Center, North Lampung Regency.

2. Methods

2.1 research location

This research case and control study was conducted in Urban Kotabumi 1 Public Health Center, North Lampung Regency, Lampung Province from November-December 2022. The population in this study were residents aged > 18 years and over in the area, where the case population was the incidence of hypertension in residents aged > 18 years or more at the Kotabumi 1 Health Center, Lampung Regency North that comes and routine measured. Meanwhile, the control population at the Kotabumi 1 Health Center were residents aged 18 years or over who did not or had never suffered from hypertension in North Lampung Regency. Sampling used stratified random sampling in determining age matching with the criteria for case and control groups with a total of 328 respondents where 164 respondents were the case group and 164 respondents were the control group.

2.2 research variables

The research variables consist of independent latent variables, dependent latent variables, mediating variables, and their indicators. The dependent variable is variable Hypertension
Hypertension Status and Hypertension Symptoms), independent latent variables include Variables Environmental (Noise and Stress Level), Variable Lifestyle (Physical Activity, Active Smoking, and Adequacy of Fruit Fiber, Adequacy of Vegetable Fiber, and Excessive Salt and Sugar Consumption), Health Service Variables (Access to Health Services and Ownership of Health Insurance), and Socio-economy Mediating Variables (Education, Income, and Employment Status).

Hypertension is measured by Hypertension Status Indicator (Y1) and Hypertension Symptoms (Y2). Hypertension status (Y1) is a blood pressure condition characterized by systolic values $\geq 140$ mmHg and diastolic $\geq 90$ mmHg. And symptoms of hypertension (Y2) are the results of measuring systolic values $\geq 140$ mmHg and diastolic $\geq 90$ mmHg in the presence of symptoms and no symptoms.

Socio-economic indicators are measured by educational level (X1), income level (X2), and employment status (X3). Education level (X1) is the last formal education taken by the respondent. Income level (X2) is the total amount of income earned by respondents for the type of work performed within one month and is calculated in rupiah values. Employment status (X3) is the type of activity undertaken by the respondent to earn income in the last 12 months.

The environment is measured by the Noise Indicator (X5), Noise (X5) is the intensity of the respondent being exposed to noise at his residence based on distance, the respondent's residence is close to a source of noise which affects the incidence of hypertension. Stress level (X6) is a history of respondents who have experienced signs and symptoms of stress in the past year with the following criteria Depression Anxiety Stress Scales (DAS 21).

Lifestyle is measured by the Physical Activity indicator (X8) where the activity undertaken by the respondent within the last 1 year by calculating the total physical activity MET minutes/week. After obtaining the total value of physical activity in units of MET minutes/week, respondents are categorized into 3 activity levels physical activities, namely high, moderate, and low levels of activity. Active Smokers (X9) is the habitual practice of respondents smoking cigarettes starting from a young age and seen from the long duration of smoking for more than 1 year with an amount of $>1$ cigarette per day. Fiber Adequacy (X11) is a history of respondents consuming fibre (vegetables and fruit) as measured by calculating the average portion in a day. The indicator of excess salt consumption (X18) is the habitual practice of the respondent consuming salt $>5$ grams ($>1$ teaspoon), and excess sugar consumption (X19) is the respondent's history of consuming excess sugar $>50$ grams ($>4$ tablespoons).

Health services are measured by the Health Service Access indicator (X12) which is the distance to health services (Puskesmas, hospitals and health clinics) and Ownership of Health Insurance (X13) which is the participation of respondents in the National Health Insurance program.

2.3 data collection and analysis

In this study, each variable is measured dichotomously based on a theoretical basis so that a model can be built regarding the actual conditions and will be proven using appropriate analysis. Data collection in this study was carried out through observation and in-depth interviews with questionnaires. Data analysis used is quantitative analysis to determine the relationship between variables using analysis Structural Equation Modelling (SEM) Smartpls 3 by explaining thoroughly the relationship between the variables in the study. Evaluation is carried out for both the measurement model and the structural model. Evaluation of the measurement model was carried out to assess the validity and reliability factor loading values as well as evaluate the discriminant validity of the research, then structural model evaluation was carried out to assess the relationship between exogenous
latent variables and endogenous latent variables as indicated by looking at the value of \( F \) square, \( T \) statistical significance of the path coefficient [18]. Testing the goodness and fit of the model is also seen with the aim and testing of model theory such as \( R \) square [15].

2.4 Ethical Clearance

We obtained ethical clearance for studies from the Research Ethics Committee, Medical and Health Sciences Program, Faculty of Medicine, University of Lampung. In addition, all respondents involved in this study who were asked to participate voluntarily received and signed an informed consent before the interview.

3. Results

The PLS pathway model for hypertension status has been developed to identify the relationship between the latent variables and their indicators as well as the correlations between the latent variables related to health care, environment and lifestyle, socioeconomic factors and hypertension status (figure 1). In this path model, socioeconomic is predicted to affect hypertension status either through other latent variables, namely health services, environment and lifestyle. The significance of the prediction of each and/or simultaneous path is analyzed by the model both in terms of measurement evaluation and structural evaluation of the model and testing the goodness or quality of a model. Path coefficients and structural models and bootstrap test results. The results of this study can be seen in Figure 1 below:

![Figure 1 PLS Path Model of Status Hypertension and Determinant Risk Factors](image)

Based on the factor loading value where the variables are measured based on the indicators to explain which is the most significant of these variables in this study the results are valid and significant, the results of this study are shown in Table 1 as follows:

<table>
<thead>
<tr>
<th>Variable</th>
<th>Indicators</th>
<th>Factor Loading</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Socioeconomic</td>
<td>X1: Education Level</td>
<td>0.857</td>
<td>Valid</td>
</tr>
<tr>
<td></td>
<td>X2: Income Level</td>
<td>0.720</td>
<td>Valid</td>
</tr>
</tbody>
</table>
To evaluate the validity and reliability of this study using Cronbach alpha values, CR values and the average value of the extract variant (AVE) in this study can be seen in Table 2 as follows:

<table>
<thead>
<tr>
<th>X3: Jobs</th>
<th>0.796</th>
<th>Valid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environment X6: Stress Level</td>
<td>1.000</td>
<td>Valid</td>
</tr>
<tr>
<td>Health services X8: Health Service Access</td>
<td>1.000</td>
<td>Valid</td>
</tr>
<tr>
<td>Lifestyle X12: Physical activity</td>
<td>1.000</td>
<td>Valid</td>
</tr>
<tr>
<td>Hypertension Status Y1: Hypertension Status</td>
<td>0.987</td>
<td>Valid</td>
</tr>
<tr>
<td>Y2: Symptoms of Hypertension</td>
<td>0.986</td>
<td>Valid</td>
</tr>
</tbody>
</table>

This study as a whole met the requirements of good convergent reliability and validity overall on the variety of measurement items.

The results of the HTMT test in this study the recommended value is below 0.90 which indicates that the pair of variables for the measure of discriminant validity is achieved or accepted. The size is stated to have a good degree of convergence with constructs or other similar variables with good discriminant rates from different constructs of other variables. HTMT is used to measure the effect of reduced measurement in SEM analysis[7]. Can be seen in Table 3 below:

<table>
<thead>
<tr>
<th>Lifestyle</th>
<th>Cronbach's Alpha</th>
<th>Composite Reliability</th>
<th>AVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environment</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
</tr>
<tr>
<td>Socio Economic</td>
<td>0.710</td>
<td>0.835</td>
<td>0.629</td>
</tr>
<tr>
<td>St_Hypertension</td>
<td>0.973</td>
<td>0.986</td>
<td>0.973</td>
</tr>
</tbody>
</table>

The test results above show that the HTMT value describes the correlation of measurement indicators on the resulting construct variable > 0.90 so that the correlation pair between constructs is good, the degree of convergence is good with similar constructs and the determinant level of different constructs.

Table 3. Ratio Heterotrait-Monotrait (HTMT)

<table>
<thead>
<tr>
<th>Lifestyle</th>
<th>Environment</th>
<th>St_Economy</th>
<th>St_Hypertension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environment</td>
<td>0.353</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Socio Economic</td>
<td>0.447</td>
<td>0.345</td>
<td></td>
</tr>
<tr>
<td>St_Hypertension</td>
<td>0.507</td>
<td>0.479</td>
<td>0.788</td>
</tr>
<tr>
<td>Health services</td>
<td>0.340</td>
<td>0.255</td>
<td>0.483</td>
</tr>
</tbody>
</table>

Evaluation of the structural model in this study by looking at collinearity, (VIF, hypothesis testing (significance path coefficient 95% CI value and F square value as well as evaluating the goodness and fit of the model (R square value).

The results of the multicollinearity test in this study are in Table 4 as follows. Assessment of the structural model can be ascertained that there are no problems with collinearity with a VIF value of < 5. The highest VIF values are found in lifestyles with hypertension status and the lowest are in economic status concerning lifestyle, environment and health services.

Table 4. VIF Value Collinearity between Variables
The research looks at the direction and path coefficients to see the strength of the relationship between exogenous and endogenous variables. The greater the value of the path coefficient, the greater the influence between variables. The results of the path test can be used to validate the hypothesis or theory being tested and can provide insight into the important factors that influence endogenous variables. The results of the hypothesis test are shown in Table 5 below:

Table 5. Direct Hypothesis Test

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Hypothesis Statement</th>
<th>Path Coefficient</th>
<th>P-value</th>
<th>T Statistics</th>
<th>Lower limit</th>
<th>Upper limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1</td>
<td>Socioeconomic → Health services</td>
<td>0.414</td>
<td>0.000</td>
<td>8.891</td>
<td>0.326</td>
<td>0.509</td>
</tr>
<tr>
<td>H2</td>
<td>Socioeconomic → Environment</td>
<td>0.297</td>
<td>0.000</td>
<td>6.683</td>
<td>0.212</td>
<td>0.379</td>
</tr>
<tr>
<td>H3</td>
<td>Socioeconomic → Lifestyle</td>
<td>0.395</td>
<td>0.000</td>
<td>8.478</td>
<td>0.304</td>
<td>0.487</td>
</tr>
<tr>
<td>H4</td>
<td>Health services → Hypertension Status</td>
<td>0.490</td>
<td>0.000</td>
<td>11.299</td>
<td>0.410</td>
<td>0.576</td>
</tr>
<tr>
<td>H5</td>
<td>Environment → Hypertension Status</td>
<td>0.263</td>
<td>0.000</td>
<td>6.277</td>
<td>0.182</td>
<td>0.345</td>
</tr>
<tr>
<td>H6</td>
<td>Lifestyle → Hypertension Status</td>
<td>0.241</td>
<td>0.000</td>
<td>4.955</td>
<td>0.148</td>
<td>0.336</td>
</tr>
</tbody>
</table>

Table 5 shows that six out of the six paths in the model are considered significant indicated by their T values > 1.96, and p-value < 0.05. But at the level of influence of the six paths, one path has a high influence, health services → hypertension status, and two paths have a moderate influence, socio-economic → health services and socio-economic → lifestyle. The other three paths have a low influence, socio-economic → the environment, environment → hypertension status and lifestyle → hypertension status. Six important paths consisting of socio-economic → health services, socio-economic → the environment, socio-economic → lifestyle, health services → hypertension status, environment → hypertension status and lifestyle → hypertension status.

Furthermore, in this study it is necessary to know the effect of mediation to see whether this research is an exogenous latent variable towards endogenous latent variables including mediation by the mediating variable this research becomes mediated or even has no effect at all, for this reason, manual calculations are needed because the output what we want in Smart PLS doesn't exist, so upsilon V is used where the effect size can be interpreted as having a
95% confidence interval based on the sampling distribution, the effect size cannot be consistent and efficient and the effect size is free from the dependence of the sample size, the formula used as follows [7].

Interpretation of the yield value uses the following interpretation: 0.02 low mediating effect, 0.075 moderate mediating effect and 0.175 high mediating effect [13]. The results of the indirect influence hypothesis test can be seen in Table 6 below:

**Table 6. Indirect Influence Hypothesis Test.**

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Hypothesis Statement</th>
<th>Path Coefficient</th>
<th>P Value</th>
<th>T Statistics</th>
<th>95% Confidence Interval Path Coefficient</th>
<th>Upsilon v</th>
</tr>
</thead>
<tbody>
<tr>
<td>H9</td>
<td>Socio economic → Health services → Hypertension Status</td>
<td>0.095</td>
<td>0.000</td>
<td>3.642</td>
<td>0.051 0.149</td>
<td>0.041</td>
</tr>
<tr>
<td>H10</td>
<td>Socio Economic → Environment → Hypertension Status</td>
<td>0.078</td>
<td>0.000</td>
<td>3.997</td>
<td>0.044 0.118</td>
<td>0.006</td>
</tr>
<tr>
<td>H11</td>
<td>Socio Economic → Lifestyle → Hypertension Status</td>
<td>0.203</td>
<td>0.000</td>
<td>5.781</td>
<td>0.143 0.281</td>
<td>0.009</td>
</tr>
</tbody>
</table>

Furthermore, referring to the results of the mediating effect in Table 6 that the three paths in the model are considered significant as indicated by their T value > 1.96, and p-value <0.05. However, in the effect test using upsilon v, one variable, health services, has a mediating effect that is close to moderate, and two other variables, environment and lifestyle, have a mediating effect that is close to low. In this study, the R Square value was obtained in Table 7 as below.

**Table 7. R Square value**

<table>
<thead>
<tr>
<th>Variable</th>
<th>R-Square</th>
<th>The Power Of Prediction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lifestyle</td>
<td>0.156</td>
<td>Weak</td>
</tr>
<tr>
<td>Environment</td>
<td>0.088</td>
<td>Weak</td>
</tr>
<tr>
<td>St Hypertension</td>
<td>0.558</td>
<td>Strong</td>
</tr>
<tr>
<td>Health services</td>
<td>0.172</td>
<td>Weak</td>
</tr>
</tbody>
</table>

Changes in hypertension status can be explained by the variables of health services, environment, and lifestyle of 55.8%, which means it has a strong influence on prediction.

### 4. Discussion

Our findings suggest that socioeconomic factors through health care, environmental and lifestyle factors significantly affect hypertension status. The results show that people with low education, low income, and precarious jobs tend to have difficulty accessing health
services, also tend to have higher levels of stress due to an unfavourable environment and
tend to rarely do physical activity due to the absence of a permanent job or seasonal work
coupled with a pattern of bad eating. These factors will increase the risk of hypertension.
These results are consistent with several reviews which state that socioeconomic
determinants through hypertension risk factors (health services, environment and lifestyle)
have not found specific research on socioeconomic determinants, health services,
environment, lifestyle and hypertension status latent variables making it difficult to see
significant comparisons that can be compared. On the other hand, several studies study the
relationship between indicators of these 3 variables and give the same results.

The incidence of hypertension is caused by various factors. There is a poor relationship
between the prevalence of hypertension and the availability of health services, although there
is a positive relationship between access and quality of health care [8]. The social economy
has a significant effect on health services with a high impact, accessibility and low quality of
health services can affect hypertension control [9]. Stress will increase peripheral vascular
resistance and cardiac output so that it will stimulate sympathetic nerve activity. This stress
can be related to work, social class, economy, and personal characteristics. There is a
relationship between individual lifestyle risk factors and the incidence of hypertension in
Australia [12]. Other research related to lifestyle is closely related to physical activity or
sports [16]. Conditions of individuals with chronic psychosocial stress can lead to
hypertension and hypertension factors [17].

Our findings show that education level, access to health services, stress level and physical
activity have the strongest correlation with socioeconomic variables, health services,
environment and lifestyle. The level of education has the strongest effect in determining the
socio-economic determinants. This result is the same There is a study on a multi-ethnic Asian
population living in Singapore using the cross-sectional statistical method of cohort
monitoring for 6 years. The results show that low education level is a factor that is
significantly related to hypertension [11]. But there are other studies in Bangladesh
Hypertension and obesity are more common in those who have higher education, with high
social economic status and live in urban areas. Individuals in higher socioeconomic status
groups are also more likely to suffer from co-morbidities [4]. This is related to the lack of
physical activity in people who live in urban areas. Regardless of the low level of education,
our findings also suggest that access to health services, stress levels and physical activity will
have the strongest effect on health, environment and lifestyle services.

Our findings also show that “factor socioeconomic” through health, environment and
lifestyle services all represent 55.8% of hypertension states. Meanwhile, the remaining
54.2% must be explained by other variables not studied in this study such as genetics, obesity,
caffeine consumption, alcohol consumption, smoking and excess fat sugar [3]. Consumption
behaviour, high sodium consumption and caffeine consumption, smoking habits and alcohol
consumption ratio [6,10-17].

5. Conclusion

We have shown that hypertension state closely related to low social determinants economy
(education, employment and income) which then also influence factors hypertension state
that is health services (lack of access to health services), the environment (high stress) and
the lifestyle of urban people who lack physical activity. Finding socioeconomic and the
significance of risk factors can be used to support control programs for hypertension in low-
and middle-income countries that have socioeconomic as the main problem that caused the
incidence of hypertension, including Indonesia. The results of this study imply that
hypertension status is not only a socio-economic variable, health services, environment and
lifestyle that influence it but other factors are not examined that need further exploration. To
find out and confirm other relationships with the incidence of hypertension in urban areas, further research is needed and the results of this study need to be implemented as an intervention strategy in hypertension control programs, especially in North Lampung Regency and in Lampung Province.

We would like to thank all health service workers in North Lampung District, especially the Kotabumi 1 health centre task force for their support during data collection.

Reference


19. World Health Organization. International Society of Hypertension Global Hypertension Practice Guidelines Hypertension. 2020;75:00 DOI: 10.1161/HYPERTENSIONAHA.120.15026.)